Passion
of SAElettrica.

Shall We Begin Now.......

We developed this platform to spread knowledge, as knowledge is the most beautiful creation of God for the beloved creation of God.

Engineers are working day and night to provide best available solutions to humanity, Since begining these solutions belongs to Air travel or time travel.

We Engineers are simply "life with idea" with passion of doing something different , we are not challenging nature but we are extracting from Nature, come with us on this journey and meet ordinary engineers with extra ordinary ideas , Let's Spread Knowledge, Let's Learn, O-Engineers Come with us...........................

We need your feedback to be more productive and getting improve

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Contents

Let's Learn

Learning is the habit of human being, this learning habit reduced the fear of failure, we learned to measure our limits, we learned to dare, our ancestor learned to live the more comfortable life when they chose to left caves and build the houses with gardens and fields, in 10th century they dared to fly like pigeons, in 14th century they dare to asked questions to the artificial supremacy of government and cultural traditions , in 15th century we dared to challenge authority of kings and queens , in 17th century we illuminated world at night by bulbs , our nights shined artificially , in 18th century we commenced our conquests of waves , in last century we were talking about time travel and game of dimensions .

What actually human being were doing in last decade is converting our learning into practicalities.

21st century is actually a century of nanotechnology, earth science , cloning , artificial intelligence , robotics , planets exploration , DNA engineering , neuroscience etc. . Human beings just want to raise curiosity limit at top. we want to cloned all known heroes and villains, we want to run back the river of time , we want to explore the dreams , we want to contact other creature on any other planets , we want to build plazas on planets although on other side we destroys our world by causing damage to OZONE and bombing our settled area .

What connecting human being is not family but learning instincts, learning informs who love us make family, learning give awareness who hate us cause relations, learning discovers who is getting happy when you enter in room cause friendship , learning told who is with you when no one is with you cause love . Human from day one of his/her life on earth start to learn the etiquettes of earth, he / she cries when need notion of mother. Although everything is about learning, even peoples learned about god from prophets.

But you know what is worst form of learning when it became the slide show and those peoples become presenter or master trainers who himself are not more than jugglers .

After year of learning I found there is only one type of learning and that is learning by involvement although there are many learning techniques, peoples are shy but they are keen to involve in the sessions. The shyness of trainees will be overcome by using these techniques.

Learning Techniques:

Two from many techniques, will share more in coming research papers.
- Think Circumstance
- Multi Hat

Thinking circumstance

In it we can create the situation and gives task to participant so they will give best available solution of certain issues raises due to given situation. Like A is a manager of furniture show room and have 3 permanent and 4 temporary employees. One of permanent employee is unsatisfied with the job due to low income and unfriendly atmosphere and one of lower cadre employee is continuously absent from job for two days (actually start working in local newspaper as office boy, but perplexed about leaving his showroom's job), now due to marriage season A will expect new orders, A have a budget of 250000 Rupees for new inventories and 25000 Rupees impress budget. You are A, What is your planning to run business in this situation?

Multi Hat:

This technique is linked with people have different attitude in different situation, what happen when you
- Need to resolve issue between your subordinates over harassment
- Need to resolve your personal conflicts with peer or fellow workers
- Need to resolve the complain of long term customer

All different situations have different solutions, these solutions must be the product of attitude adjustment.

About the Author: Arsalan Hamid is Testing and Commissioning Engineer, serving in Oman. Wrote two books till Date and Editing Engineer of "O-Engineers" Magazine.

Company Profile

- Established in Y2013, born from a leading transformer manufacturer.

- With a experienced and responsible & passionate team.

- Specialize in power distribution system, rectifier system and control system.

- Our expertise & operative attitude win us trust from both suppliers and delivered customers.

- Authorized by several renowned manufacturers for their oversea business.

- Strong network and know-how to China electric supplying market.

Products & Services

- Our expertise & operative attitude win us trust from several renowned manufacturers. We are authorized for their oversea business.

- All of our partners are all in the leading position in their respective area.

Transformer	Switchgear	Instrument Transformer	PFC panel	Rectifier System	Spare Parts
➢ Distribution transformer ➢ Power transformer ➢ Special transformer	➢ Breaker ➢ LV switchgear ➢ MV switchgear ➢ MCC	➢ LV CT PT ➢ MV CT PT ➢ HV CT PT ➢ Surge arrester ➢ Bushing	➢ LV Power Factor Compensation Panel ➢ HV Power Factor Compensation Panel ➢ Motor soft starter	➢ Low current rectifier ➢ Medium current rectifier ➢ High current rectifier ➢ DC current sensor ➢ DC isolator ➢ Cooling system	➢ LV components ➢ PLC ➢ Instrument & relay ➢ Thyristors ➢ Cable ➢ ......

Product – Global brand Products

➢ We have very good relationship with ABB. We supply products from **ABB**, **SIEMENS**, **Schneider** and other global brand products.:

- ✓ Breaker (VD4) switchgears (LV, MV, HV).
- ✓ DCS system.
- ✓ Motor, AC drive & DC drive.
- ✓ Rectifier.
- ✓ Capacitor and Power Factor Improvement panel.
- ✓ Protection relay.
- ✓ Instrument transformer.
- ✓ Instrument.
- ✓ LV components.

Concept of Quality Management system for Engineers

Rajagoplan Balaji

This article is for engineers working in various sectors and different positions with numerous tasks to improve the performance of the business of our organization. The ultimate aim for all of us is to meet the requirements of the customer and to fulfill the demands of our management. While we execute various tasks provided and try to involve with numerous data as well information related to processes such as sales, purchasing, inventory, , products and services etc., in order to review, improve and co-ordinate all these information information to come out with most appropriate conclusions as deliverables

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and to prioritize the actions for which Quality management system is one of the best framework.

Every engineer day in and day out working seriously with dedication and looking at opportunities to prove their capability in organizations, when it comes to presenting what have been done till now we could not able to project the same properly in front of the customers and to our own management. Some or the other day we feel our performance is not improving and we try to do our own the routine activities.

Management of any organization provides opportunities to all of us to prove our performance and we should know the strategies and create road map on how to convert the opportunities into success. Leaders in the form of management is really looking at exacting efficient work from all of us. One of the better way to achieve the confidence of the management is following the principles of quality management system.

The revisions were made to suit the current expectations of the customer and management in order to provide right products and services. Concepts which are known globally and taught by quality guru's found conceived and built in the standard.

Seven quality principles – customer focus, leadership, Engagement of people, process approach, improvement, evidence based decision making, relationship management – found covered and the same is applicable to not only organization and also to each and every individual working in the organization in their professional and personnel life.

Plan- Do- Check-Act – **concept PDCA Cycle also found captured in the quality management system.**

Widely used in every organization at all functional levels to prove the effectiveness and efficiency of the work performed. While we have to give maximum emphasize in the planning compartment in order to avoid the firefighting and make sure the activities are performed as planned. Engineers like us play a major role in the planning portion as this decides the success of the task. Most of us feel the planning portion is taken care by the management and our involvement happens in execution, however the fact remains management provides the outline of course investment and rest of the planning is supposed to be done by us in our process / functional level.

Quality management system takes out the concept of departmental approach (compartmental approach) as the world requires process approach. The process approach requires people from different functional resources to achieve the goal. The advantage of this approach were team building, leadership development, deployment of work, and multi skill development.

We normally will be looking at our activities and verify whether our activities are smooth but the fact is other functions are dependent on us and we are also dependent on other functions to achieve our task. Working as a cross functional team (CFT) provides that edge over to obtain the desired output.

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With lots of information which we carry in our notebooks, computers to what extent being used, we provide these information in many ways to satisfy our customers. As engineer it becomes our responsibility to collate all this information in relation to our objectives (goals) and try to estimate further resources which is required to achieve the same. Often we feel that we are not getting the resources what is required and most of the times we may not know the requirements itself. Quality management system provides four different types of checking to arrive at our performance as organization level and we are the pillars of the organization, which are –

1.	Checking how much the customers (to whom we are making the product /performing the services)

2.	Checking with the data (information) what is our performance level within ourselves,

3.	Verification done by other personnel who are not directly or indirectly responsible at process level to evaluate our performance in the form of internal audit

4.	Reviewing with the management and providing information about out process and getting directions /guidance from management.

 We generate many documents and records (documented information) in order to provide evidences and to review our performance and uplift our performance which in turn improves our organization brand in front of our customers /market. However as engineers it is our responsibility to provide precise and accurate information based on the records to our management so that they take the organization to higher level. Because management cannot verify all the activities of the organization and that is the purpose of our presence in the organization.

The above contents are a summary and QMS standard covers much more too each and every activities of any organization, kindly have a glance and put in practice in your work as it is one of the way to achieve your goals.

To conclude - Quality management system provides Way Of organization's life. Few of the other tools available – TPM,TQM, Six Sigma, Lean management system, Lean six sigma, Statistical process control, Measurement system analysis which further enhances the improve- -ment in our organization and can be elaborated in Upcoming editions.

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About the Author: Balaji is IRCA Approved Auditor and Trainer with excellent professional credentials.
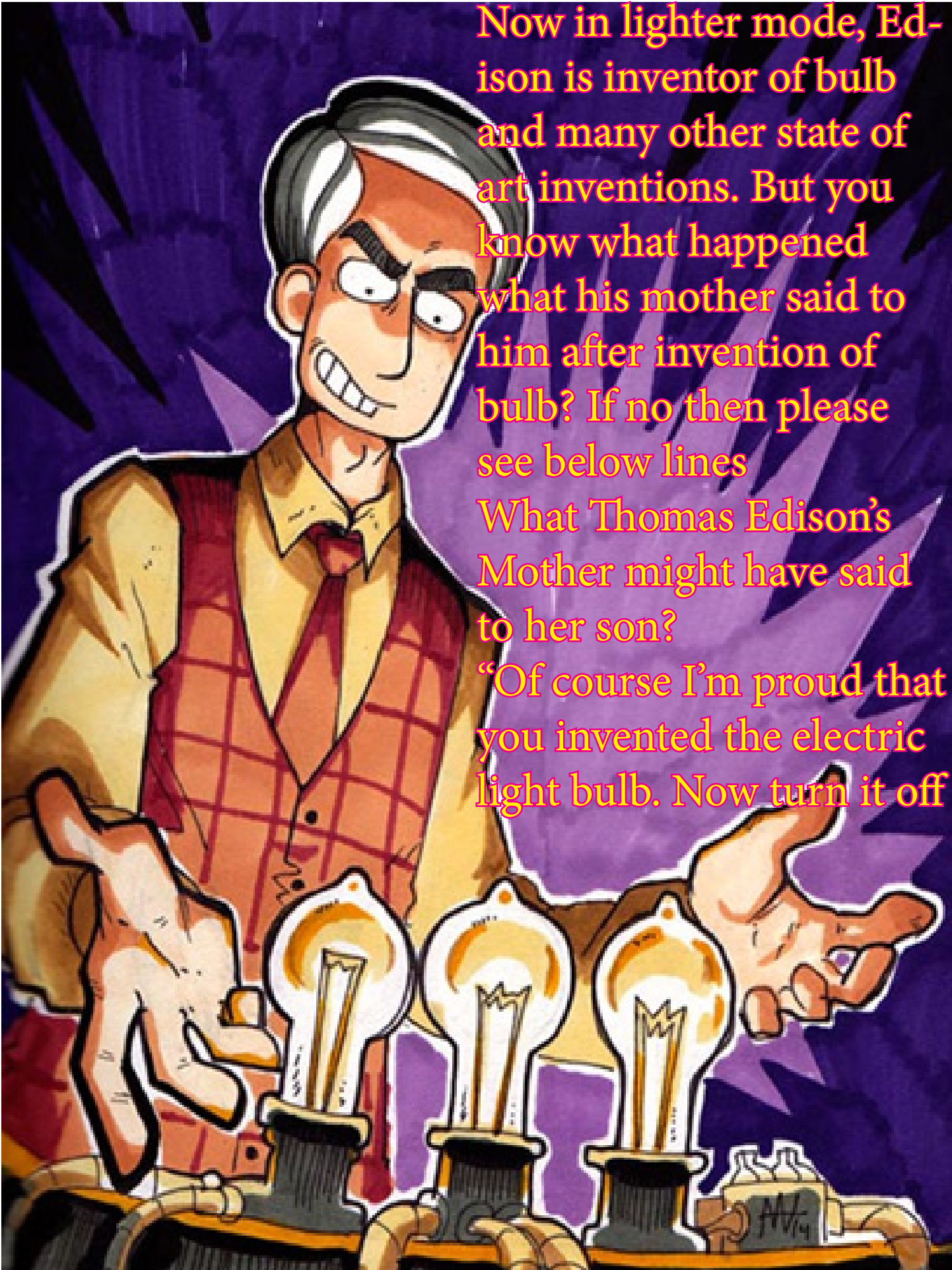
Engineering Fun

Qazi Arsalan Hamid

Thomas Alva Edison

There is one famous story about Edison, which he told that when he was in school he received one letter for his mother from school, when he handed over letter to mother and sat beside her to listen what school administration was asking from his mother in letter, his mother started reading letter in which as per her mother school administration said that your son is so excellent in education that current school education system is par behind his skills so it is suggested by school that Edison get his education somewhere else or at home and will not waste his talent in this school.

Edison after hearing that was so proud of his school, after this event his mother started teaching him at home. After many years of this event, when Edison got name in science field as one of the world most renown inventor of all time he faced tragedy of his mother loss, he returned home and while cleaning one of the drawers he found that old school letter, he enthusiastically started reading letter, in which it was written that your son is not good in studies and become hurdle in other student's education. So for the betterment of school we are cancelling his admission in our school, this is for your information.

Edison was shocked after reading this letter, he was broken in tears and thought how great his mother was, if his mother did not tweak the mode of letter their might be broken Edison but not an inventor Edison.

Now in lighter mode, Edison is inventor of bulb and many other state of art inventions. But you know what happened what his mother said to him after invention of bulb? If no then please see below lines

What Thomas Edison's Mother might have said to her son?

"Of course I'm proud that you invented the electric light bulb. Now turn it off

Werner Heisenberg:

Heisenberg is famous for his theory of uncertainty (this principle concerns about the uncertainty in position of matter), there is one famous fun liner about him that peoples said there is sign in a munch that reads," Heisenberg might have slept here"

Albert Einstein:

Albert Einstein is the man who changed the scope of science and became one of the founding father of modern science, Einstein did lot of work in energy, matter, space and time, this work is base of modern world inventions, there is one mythical joke about him that said One day, Albert Einstein was feeling very guilty about spending all his time thinking about the Universe and thereby neglecting his family. So he decided, that this night, he would tell his younger son Eduard a bedtime story. Einstein say down in a chair by the bed and began, "Once upon a space-time
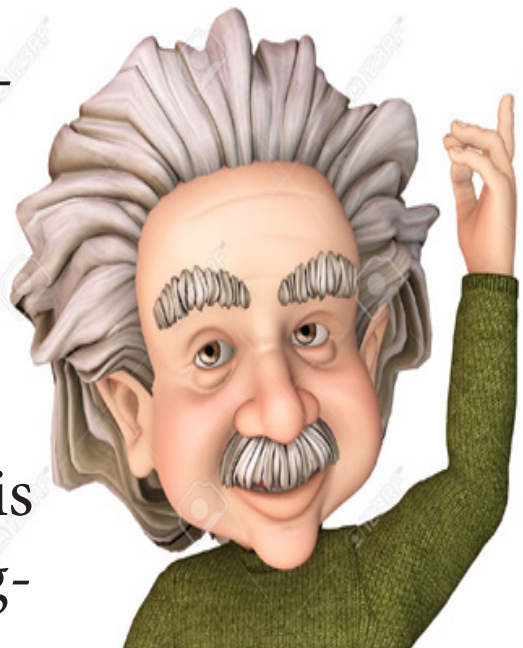
er plant of SONICO (BS) - Italy

rom 3 generation of workers in

cal field)

Ing. Marco's Passion

Passion before business is the attitude of SAElettrica founder, Daniele Branchi. This passion was spread and share also at the staff who work with us.
SAElettrica was founded in 2003 as spinoff of Branchi's Family company SEB Servizi Elettrici Branchi (active since 1991 and still), focused in ground plant test with step and touch voltage, thermography and faraday's cages test.
SAElettrica has been followed since 2005 by Daniele and Marco, his son, with same attitude in passion and magister degree in electrical engineering grant by Politecnico di Milano.
The boost of young force and knowledge was important to create the base of organization's company, such ISO 9001, internal and external

training, procedure, and trying to growth a team focused on the best technical results. At the end, after 14 years, we can say: "We are best in the field in every aspect".

Our turn over is very low, several technicians work with us since SEB's era and follow us in SAElettrica, as demonstration of a good relationship between people and the possibility of improving their professional skills.

SAElettrica's core business is electrical protection set and testing, from factory (FAT), commissioning, trouble shooting, fault analysis, maintenance routine tests.

We think protection "box" without deep acknowledge of surrounding is a poor scholastic exercise in laboratory. For this reason we enlarge our activities using protection system as our central core, so we study and test "surrounding" like CT, VT, breakers, switchgear, cables, transformers and generators and conducts coordination study

Our approach in market is different in respect to competitors: we avoid to concentrate our business in a single part of market or with big client, we even accept clients who want protection testing and calibration of energy meters of his small photovoltaic plant, but we also have experience in executing contract longer than 5 years with multinational companies, including all the measurement and test used normally in maintenance scheduling. This kind of attitude expands our experience and skills, and the best experience sometimes we got in small duration Contracts, we can say, we are getting lot of experience from every client.

We got two other points of distinction: we haven't have any type of collaboration with manufacturers, so we are free to evaluate any equipment without any kind of influence. In the meantime we are available to work with everybody without restrictions, so we can test all kind of Equipments in the market. This is the part we are excited in our job.

We are expert in any equipment testing and maintenance from ABB to Siemens, from Schneider to SEL etc. without problems.

The second point of distinction is: no restriction area. We did projects in hydroelectric plant, new or revamp; thermal plant, small and special (8 MW or less) to traditional (380x2+300 MVA or more); high voltage substation; medium voltage distribution in steel factory, oil and gas, petrochemical, paper factory, desalination, gas... at least only offshore is missing, but we will reach them too.

Including SEB era, we can get 26 years of experience of protection's market and commissioning, testing from electromechanical old ladies (as we love to call old relay makes) to the shining last IEC61850 IED developed in last years, passing from hybrid, electronic and first digital protections.

Author's information: Marco Branchi is Serving Executive of SAElettrica with 20+ years hand on experience in Testing and Commissioning.

Usaid Javaid

Around The Internships
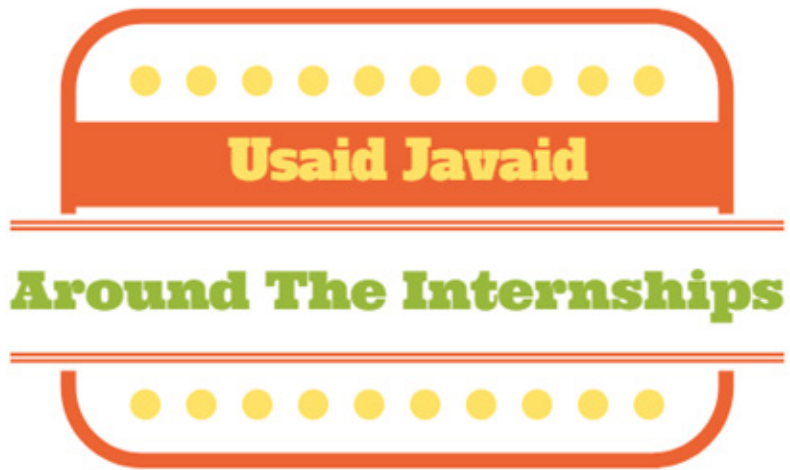
Towards the end of second year, one thing that comes most often in the minds of engineers of NED is the excitement of Internship. In NED university complete emphasis is on the theory, and practical knowledge of students is quite low so Internship is necessary for NEDIANS and its desired aim is to gain the practical knowledge, NED is arranging Internship for the students in two sessions, first in the summer which is normally of six weeks and the other in winter which is for a shorter period of time. For this purpose the department of industrial liaison (DIL) arranges Internships for various students. Perhaps, there is no denying the fact that nothing could be as monumental as Internship.

In this article we will discuss about some various aspects of Internship.

No matter where you intend to intern, preceding to applying for an Internship, you must cater for the following:

✓ Prepare a professional resume, clearly stating your purpose

✓ Prepare yourself for the interview. It is not like the job one but you are questioned about some basic concepts you have covered up till

✓ Get yourself well-acquainted with the various software's, especially MS-Office, and Photoshop

✓ If you know where you are going to intern, keep yourself updated with the company history, vision and products

How to Apply

Do start visiting career section of multinational companies from the start of 5th semester.

Do pay attention on Notice boards. Companies like Nestle, Unilever, DESCON, P&G, ENGRO, Telenor, & PSO there you have to give test & interview then you will proceed. There are numerous companies where you would do Internship like Karachi Electric, Schlumberger, Siemens, Schneider, Pakistan Steel mill, Gul-Ahmed, Johnson & Phillips, PEL Power Division, NESPAK, FND, PIA, PSO, PPL, NRL, FFC, BYCO, Atlas Engineering, NTDC, CAA, Allied-Cat, FFC, Lotte, Asia Petroleum, SUPARCO, KANNUP, EA Consultancy, KP Associates and SSGC.

During Internship

It is always beneficial to display your best professional approach during Internship period because 80% MNCs (Multinational Companies) hire peoples which had already worked there as Internee. You should take care of following things;

;
✓ During Internship, don't sit idle
✓ Actively participate in all team activities (never think u r not a part of this organization).
✓ Dress as per company trends. (Formal is not preferred everywhere, the term they use now is Smart casual).
✓ Never hesitate to ask anything u not understands.
✓ Try to develop basic knowledge of company processes and internal software's they are using in daily tasks.
✓ Try to develop good relationship with the employees. (It will help u afterwards.)

Benefits in private sector

✓ Private sector maintains a much formal office environment and one gets a real taste of the 9-5 life.
✓ One usually happens to meet the gentry in the private sector which is quite substantial for one's personal & professional grooming and growth.

✓ Healthy stipends.
✓ Certificates along with letter of recommendation are issued to the intern without much ado.
✓ Proper meals, tea/coffee and safe drinking water.

Before Signing Off

Suggest your supervisor/manager to take your presentation or interview regarding the area where you have interned. Though it is normally asked, even if not, submit a report upon your Internship to the Person in charge. Take the company cards of relevant persons, it will help you in future.

Feelings after Internship

I feel you should come out of it strong and confident. You should have learned new skills or developed old ones, which you can later apply to a future job.

Great connections should have also been formed. I like to know that I can accomplish anything, rather than, be tired and be thankful the Internship has ended.

How many Internships?

Well, it is always a good question to ask, how many Internships must one do? Well, the answer is quite simple one at least, two at most. It should however be keep in the mind that if one prefers to do Internship more than one, they all should be done in the same field, don't try to be inventive in that manner, for between two stools you will fall to the ground.

About the Author:

Usaid Javaid is Serving engineer in National Refinery Limited Pakistan, Graduated from Pakistan renowned University NEDUET Karachi in 2014.

Engr. Rashid Hussain

Robust Speaker Recognition

A feature based approach

Speaker recognition is conceded with extracting the identity of the person speaking the utterance. In today's modern world, as speech interaction with smart computers becomes more persistent in day to day activities, the utility of automatically recognizing a speaker increases. Speaker recognition can be text dependent in which recognizer works on pre-trained data, or it may be text-independent where there is no constraint on the spoken words by the speaker.

The techniques for speaker recognition can be categorized into three major approaches.

The first and earliest approach uses long-term averages of acoustic features, such as spectrum representations or pitch. Second approach models the speaker-dependent acoustic features within the individual phonetic sounds that comprise the utterance. Third and the latest approach is the use of discriminative neural networks (NN). Speech and speaker recognition in general are the subset any pattern recognition. Thus, three stages are applied in any speaker recognition task (1) training (2) testing and (3) implementation.

The logic behind the speaker recognition is to classify the differences in speaker's articulatory organs, shape of vocal tract, size of the nasal cavity, speaker intonation and speaker prosody to identify the speaker correctly. Furthermore, a language model can be used to improve the performance. In actual, significant errors introduced in the training and testing data due to the inclusion of environmental noise, , convolution or white noise, and speaker's

accent which leads to misidentification of speaker which ultimately results in performance degradation of recognizer.

There are various feature extraction techniques which claims to be robust while performing in such environmental conditions. As far as pre-processing stage is concerned, Linear Predictive analysis (LPC) is assumed to be the first step of feature extraction and other robust cepstral feature derived from linear predictive coefficients are then utilized.

Linear Prediction of Speech:

Since speech is produced by the movement of anatomical structures such as vocal cords, vocal tract, nasal cavity, tongue, and lips. Linear model of speech is first proposed by Fant in late 1950s where the glottal pulse, vocal tract, and radiation are individually modeled as linear filters. A complete model of speech production is shown in the figure.
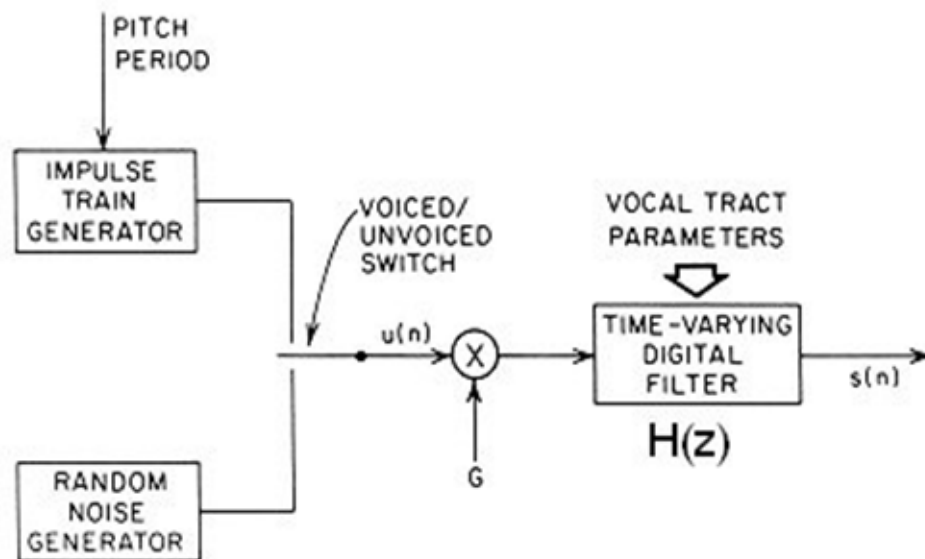
Two major steps are involved in the general feature extraction for speaker recognition. First a set of predictors coefficients are determined by the LPC analysis and in the second step these coefficients are transformed into feature vectors.

The basic idea behind linear predictive coding (LPC) is that a sample of speech can be approximated as a linear combination of the past 'p' speech samples. By minimizing the square difference between the actual speech samples and the linearly predicted ones, one can determine the predictor coefficients; i.e., the weighting coefficients of the linear combination.

Combining the effect of glottal pulse, vocal tract, and radiation yields a single all-pole transfer function as below:

$$H(z) = \frac{G}{1 - \sum_{i=1}^{p} a_i z^{-1}}$$

Where,
'G' is the gain factor (Usually ignored to allow the parameterization to be independent of the signal intensity)
'ai' can be computed from speech signal

It is generally an all-pole model for most speech sounds. By using the above transfer function we can synthesize the speech samples as a linear combination of the previous 'p' samples. Therefore, the speech production model is often called the linear prediction (LP) model, or the autoregressive model.

Since speech is slow time-varying process, an accurate set of predictor coefficients is adaptively determined over short intervals (10 ms ~30 ms) called frames, during which time-invariance is assumed. The autocorrelation method and the covariance method are two standard methods of solving for the predictor coefficients. [1, 2]

A robust solution technique will result in the vocal-tract information being captured by Hz, whether speech is clean or corrupted by noise and/or channel effects. Then, the predictor coefficients would either be invariant or show very little variation when speech is corrupted. Subsequently, the features would be naturally robust. [3]

Another attempt at representing the speech spectrum involves an approximation that gives more emphasis to those frequencies that have greater auditory prominence.

This is known as perceptual linear prediction (PLP). The actual speech spectrum (obtained by a DFT of the speech samples) is modified based on the principles of critical-band auditory masking and the unequal sensitivity of human hearing at different frequencies [4].

The next step is to convert the predictor coefficients into feature vectors. Examples of such vectors include the predictor coefficients themselves, cepstral coefficients and their derivatives, line spectral pairs (LSP), log area ratios
(LAR), vocal-tract area functions, and the impulse response h (n) of the filter H(z) [5]. For speaker recognition, the cepstral coefficients were found to provide the best results [6].

Cepstrum provides a good measure of the difference in the spectral envelope of the speech frames that the cepstral vectors were derived from.

For text-dependent speaker recognition, improved performance has been found by introducing cepstral derivatives into the feature space as it captures the transitional information in the speech. Cepstral weighting or liftering is also used which enhances the speaker recognition. Cepstral mean subtraction (CMS) technique also significantly improves the performance of a recognition system in which training is done on one channel condition while testing is done on another channel condition. Another technique, known as Pole-filtered Cepstral Mean Subtraction (PFCMS), modifies the LP poles so as to broaden the bandwidth of the formant poles. The cepstrum formed from these modified poles has less speech information and more channel information. It has noticed that PFCMS outperforms CMS in speaker-identification problem.

The relative spectral (RASTA) technique takes advantage of the fact that the rate of change of nonlinguistic components in speech often lies outside the typical rate of change of the vocal-tract shape.

Therefore, it suppresses the Spectral components that change more slowly or quickly than the typical rate of change of speech. The RASTA approach can be combined with the PLP method to get the LP transfer function Hz [7]. Unlike cepstral mean subtraction, which removes the dc component of the short-term log spectrum, RASTA processing influences the speech spectrum in a more complex manner and emphasizes spectral transitions. The use of RASTA processing has been shown to improve speech-recognition performance under mismatched environments. This band pass operation, combined with BPL filtering, has been shown to improve speaker-recognition performance under mismatched conditions.

However, this is not the end, currently speech recognition communities are working on GMM and HMM, Long Short-term Memory RNNs based approach as well as deep neural network which takes the speaker recognition to the next level and

increases the performance to the greater extent and it is believed that there is the potential for considerable further improvement.

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Breakdown

Mechanisms of Liquid Dielectrics in Transformers

Muhammad Noman
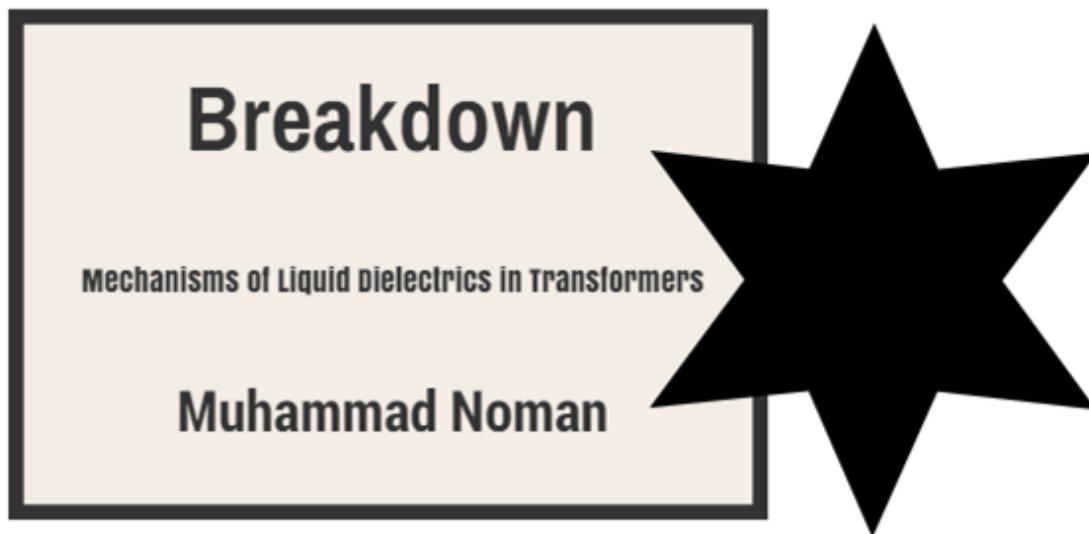
Liquid Dielectrics are extensively used in high voltage Cables, Capacitors and Transformers & Circuit breakers. In addition to their function as an insulator, liquid dielectrics also act as heat transfer agent. Liquid dielectric generally has breakdown strength of 1 MV/cm (i.e. 10 times more than the dielectric strength of gases) and act as cooling agent in Distribution Transformers as well.

Chemical Composition of Transformer Oil:

Liquid dielectrics are derivatives of crude oil and contain either long chain hydrocarbons or ring structure hydrocarbon compounds termed

as Paraffinic & Naphthenic respectively. Naphthenic base oil is most widely used compare to Paraffinic, which forms sludge at low temperature.
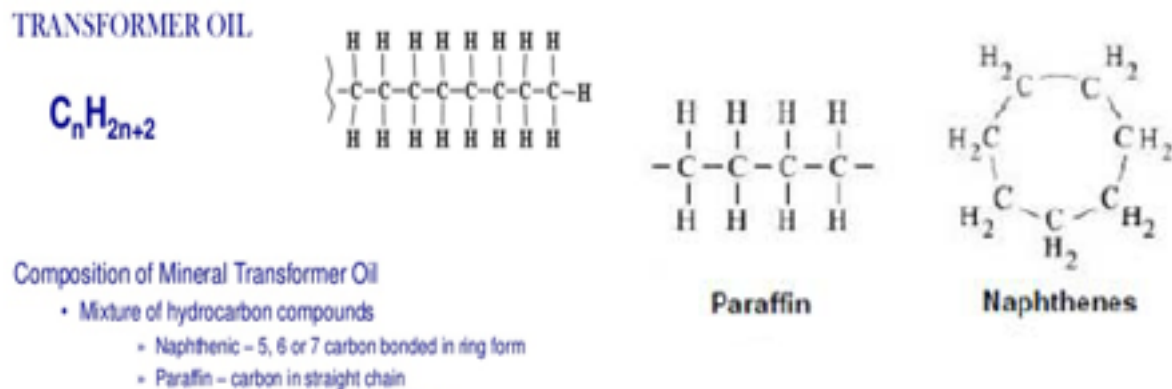

Fig (i).Composition of Hydrocarbon Compounds in Transformer Oil

Breakdown Mechanisms of Liquid Dielectrics in Transformer

Insulating liquids are not chemically pure and contain certain impurities like gas bubbles, suspended particles in the form of fibrous & conducting impurities which reduce the breakdown strength of these liquids considerably (presence of 0.01% moisture content in liquid dielectrics reduces its strength by

20%) and ultimately result in to the insulation failure Several theories have been proposed to explain the breakdown mechanism in liquid dielectrics. For case study two different mechanisms will be discussed here;

a. Cavitation or Bubble Mechanism
b. Suspended Particle Mechanism

(a) Cavitation or Bubble Mechanism:

Gas bubbles may produce in liquid dielectrics due to the vaporization of liquid by corona-type discharges from sharp points/irregularities on the electrode surfaces or inclusion of moisture from air through transformer breather producing water bubbles in the liquids. Irrespective of the type of mechanism, once a cavity or bubble is formed in the liquid dielectrics, it will be elongated in the direction of electric field due to applied voltage and gradually bridges the gap in transformer tank resulting in to the subsequent breakdown as shown in the
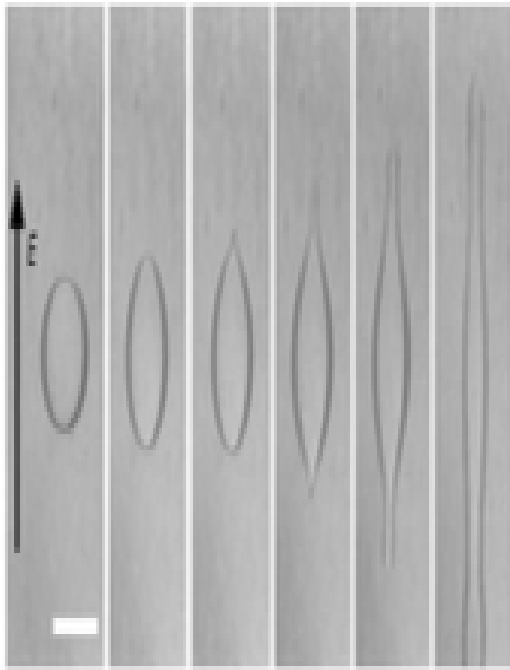
figures below;

Fig (ii).Elongation of Bubble in Liquid Dielectrics in the direction of Electric Field
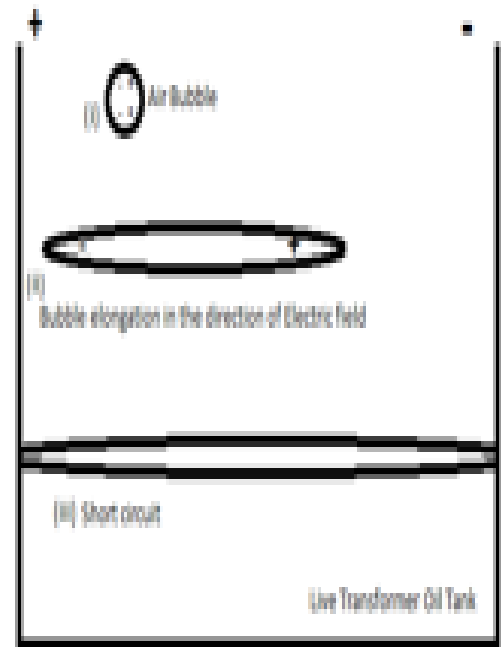

Fig (iii).Sequence of Elongation of a bubble under Electric Field

Instead of elongation, there are also chances that a bubble may burst resulting in forces that will produce more bubbles in the dielectric liquid. Similarly small bubbles may nucleate to form a large bubble, which elongates under the influence of electric field , thus causing breakdown by the mechanism already discussed above.

(b) Suspended Particle Mechanism:

The presence of solid impurities cannot be avoided. These impurities will be present as fibers or as dispersed solid conducting particles, especially in transformers. The fibrous particles are disposed-off from Bakelite or cloth insulation of the winding, whereas the conducting particles are introduced from steel tank structure during service conditions. These particles are polarized under the influence of electric field and thereby are aligned forming a stable chain binding the gap causing short circuit resulting in break down as shown in fig (IV) below. If there is only a single conducting particle, it will give rise to local field enhancement depending on its shape. If this localized field exceeds the breakdown strength of the liquid, local breakdown will occur near the particle, and this will result in the formation of gas bubbles, which may lead to the breakdown of liquid by Cavitation mechanism.
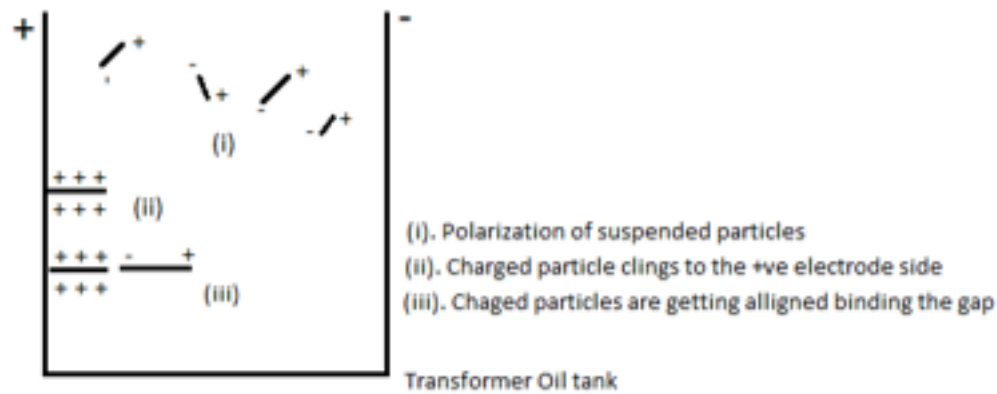
(i). Polarization of suspended particles
(ii). Charged particle clings to the +ve electrode side
(iii). Chaged particles are getting alligned binding the gap

Transformer Oil tank

Fig (IV). Suspended Particles Mechanism

References:

(i). http://www.electricalindia.in/blog/post/id/11603/significance-of-transformer-oil-monitoring

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(iii). High Voltage Engineering Book (Theory & Practice) by Prof. Dr. Muhammad Naeem Arbab

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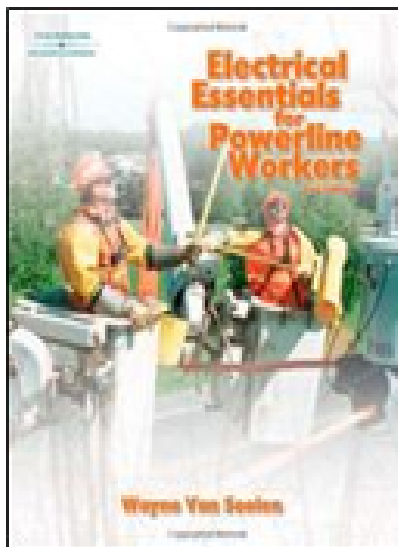
Electrical Essentials for Power line Workers by

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